

IMMANENT CAUSATION*

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This immanent operation, which develops state out of state within one and the same essential Being, we treat as a matter of fact, which calls for no further effort of thought. That this operation in turn remains completely incomprehensible in respect of the manner in which it comes about, we are meanwhile very well aware.

Hermann Lotze¹

The notion of “immanent causation”—central to Hermann Lotze’s *Metaphysic*, and later taken up by C. D. Broad and W. E. Johnson—has recently been revived and put to work on behalf of the doctrine of temporal parts. After a glimpse at the role immanent causation played in the theories of Lotze, Johnson, and Broad, I describe the task set for it by contemporary temporal parts theorists, such as D. M. Armstrong. I then build up an analysis of immanent causation which serves the new purpose, and show how immanent causation has a place even in the theories of those who reject the metaphysics of temporal parts.

I. Immanent and transeunt causation in Lotze, Johnson, and Broad

Immanent causation was typically contrasted with “transeunt causation” in the following way: In transeunt causality, says Johnson,

the cause occurrence and the effect occurrence are referred to different continuants, whereas in immanent causality cause occurrence and effect occurrence are attributed to the same continuant.²

Similarly, Lotze says that the “mystery” of “‘transeunt’ action” is “how it can come about that an occurrence happening to the one thing *a* can be the occasion of a new occurrence in the thing *b*”³. In immanent causation, on the other hand, “a state *a*¹ of a thing *a* begins to bring about a consequent state, *a*², in the same

thing”⁴—a process which, as the epigraph illustrates, Lotze finds no less mysterious than the transeunt case.

Lotze contrasts his own view of the relationship between the two sorts of causation with that of Leibniz:

In each single Monad, according to Leibnitz, state follows upon state through an immanent action, which is accepted as a fact, unintelligible indeed but free from contradiction. It was only ‘transeunt’ action of which the assumption was to be avoided.⁵

Thus Leibniz reduces transeunt causation to immanent-causal relations among the earlier and later states of the smallest things, the monads; transeunt causation is explained away by means of the pre-established harmony. Lotze agrees with Leibniz that transeunt causation is to be reduced to immanent causation; but he goes in the opposite direction, replacing apparent cases of transeunt causation among smaller things with immanent-causal relations among states of the whole universe. Thus the favoring of immanent over transeunt causation leads in Leibniz’s case to “substantial pluralism”, in Lotze’s to “substantial monism”.⁶

Johnson, on the other hand, accepts both sorts of causation as real, neither reducible to the other:

[T]he conception of immanency cannot be eliminated in the formulation of physical laws; because the effects upon one body due to transeunt action from another are modifications of what *would be happening* within the body were no such transeunt causality in operation.⁷

There are, in other words, no purely transeunt causal relations. In fact Johnson holds that “any concretely described causal process must be analysed into a conjunction of transeunt and immanent causality; and neither types of causality are to be found actually separate.”⁸

Broad, on the other hand, concludes that the distinction is not a deep one. In his Fellowship dissertation, published as *Perception, Physics, and Reality*, he takes something like a temporal parts approach to continuants, rejecting any sort of “permanent substratum” and identifying persisting things with spatiotemporally continuous sums of event-like stages, these stages themselves consisting of spatiotemporally located “qualities”.⁹ He thinks the “common-sense of immanence as Lotze and Leibniz use the term” can be defined in terms of the holding of causal laws that take as “data” only qualities that fall within the boundaries of a single persisting thing—where the latter is just a series of stages that exhibit a certain sort of spatiotemporal continuity.¹⁰ Thus, on Broad’s view, the concept of a persisting thing can be explicated without appeal to any causal considerations; and the distinction between immanent and transeunt causation is made in this way: if a pair of causally related “qualities” happen to fall within the boundaries of a spatiotemporally connected series of more or less similar object-stages, then the relation is one of immanent causation; otherwise, not. The difference between immanent and transeunt causal relations is, therefore, purely adventitious. If cause

and effect stand in certain extrinsic relations to other events, then they constitute a case of immanent causation; if other extrinsic relations hold, the causal relation is transeunt. But there need be no intrinsic difference between cases of immanent and transeunt causation.

II. Immanent causation in causal theories of identity

Was Broad right to think that some form of spatiotemporal continuity is both necessary and sufficient for a series of stages to constitute a single persisting thing? The seeming logical possibility of “smooth replicas”¹¹ or “immaculate replacements”¹² suggests that he was not. Sydney Shoemaker and David Armstrong tell stories—involving deities, or creation and annihilation machines—designed to illustrate that the spatiotemporal continuity of a series of “person-stages”, or “table-stages”, with as much qualitative continuity as you like, cannot guarantee that the stages constitute a single person, or table.¹³ In Armstrong’s example, one deity annihilates Richard Taylor while another—acting independently, and unaware of Taylor—creates *ex nihilo* a Richard Taylor look-a-like. And it so happens that the product of the second deity’s activity appears at the time and place of Taylor’s annihilation, so that there is no spatiotemporal gap between Taylor’s stages and those of his doppelgänger. It seems clear that, were this situation to obtain, the person-stages before the deities went to work would not be stages of the same person as the person-stages caused by the creative deity, despite the spatiotemporal continuity of the series as a whole.

It is extremely tempting to draw the following moral from such cases: spatiotemporal continuity is, at best, an epiphenomenon of persistence. What is absent in immaculate replacements is causal dependence of the later stages upon the earlier stages; the later stages are not the way they are because the earlier stages were the way they were; the later stages do not “evolve out of” the earlier stages, as they should in the case of a genuine persisting thing. Once the importance of causal relations among stages is recognized, the significance of spatiotemporal continuity begins to fade. Stories involving objects that jump discontinuously start to sound plausible, as long as the right kind of causal connections are preserved among the stages of a given jumping object.¹⁴ Armstrong draws the moral succinctly: “Spatiotemporal continuity of phases of things appears to be a mere result of, an observable sign of, the existence of a certain sort of causal relation between the phases.”¹⁵

Thus there has been a return to the sort of causal theory of identity one finds in Bertrand Russell. Russell believed that mere spatiotemporal “continuity is not a sufficient criterion of material identity.”¹⁶ He put his stock, instead, in causal relations among stages: A persisting thing is said to be a “string of events, connected together by certain causal connections, and having enough unity to deserve a single name.”¹⁷

At this point it is worthwhile to note a potential difference among the friends of temporal parts. Many—perhaps most—follow Quine in allowing that any set of temporal parts, however spatiotemporally disconnected or dissimilar its mem-

bers, has a sum or fusion: a whole that has each member of the set as a part and that has no part that fails to overlap at least one member of the set. Others may seek to resist such mereological prodigality by requiring that a set of temporal parts meet certain conditions if it is to have a sum. The latter philosophers, who may be called “Mereological Conservatives”, obviously have a good deal at stake in the debate over whether causal connectedness or spatiotemporal continuity provides the real means for determining which sets of stages constitute persisting things. For the Conservatives will regard the outcome as settling which temporal parts constitute temporally larger wholes, and which do not. Now it might seem that, in contrast, the Mereological Quineans have no deep stake in the search for particular causal conditions that will render a set of stages sufficiently unified to qualify as a persisting thing. After all, since every arbitrary collection of temporal parts has a sum, the Quineans think that *any* collection of nonsimultaneous temporal parts constitutes a whole that “persists”—at least in the sense of existing at more than one time. No special conditions, beyond nonsimultaneity, need be met. But, in fact, these questions are as instant for Quineans as for Conservatives. Quineans, too, need to be able to recognize the difference between a set of person-stages that compose a single person and a set of person-stages that do not; a set of table stages that make up a single table, and a set that does not; and so on. What the arguments of the causal theorists seem to show is that these distinctions involve the presence and absence of causal connections, and not spatiotemporal continuity and discontinuity.

The precise role causal considerations play in “criteria of diachronic identity” is not settled simply by acceptance of the morals drawn from the possibility of immaculate replacement. Surely the kinds of causal dependencies that must hold between earlier and later stages of a person, say, will be different from those that must hold between earlier and later stages of a table. Indeed, I expect that, for radically different sorts of persisting things, very different criteria of identity must be found. But, if the causal theorists are right, in each case causal connectedness among stages will emerge as an important element in, or at least a consequence of, any plausible account of such criteria.¹⁸

Something like a *generic* notion of immanent causation also has, I believe, a place in causal theories of identity. For at the level of the simplest kinds of persisting substances—whatever they may be—there would seem to be precious little needed (or available), beyond appropriate causal connections, to unite stages into persisting wholes. It is at precisely this point that David Armstrong, with a nod towards Johnson, introduces a notion of immanent causation as a part of his theory of temporal parts:

Certain wholes maintain their stability by the interactions of their proper parts. In general, that holds for social wholes, such as nations. That is transeunt causality. But it may also be that there is a form of causality which remains confined to a single particular and that, further, does not proceed by interaction between sub-particulars. This will be immanent causality.¹⁹

Armstrong goes on to say that, if one accepts that persisting objects have temporal parts, then one faces a problem the resolution of which requires recourse to immanent causation:

The problem is to give “principles of unity” by which non-overlapping temporal parts of the one particular are welded together to constitute the single thing that exists through time. Mere spatial and temporal continuity, together with resemblance of temporal parts, can be shown to be insufficient. Indeed neither sort of continuity seems even to be necessary. ... What seems necessary in addition is the actual *bringing into existence* of later by earlier temporal parts.²⁰

I shall argue below that Armstrong is right to think that the friends of temporal parts owe us “principles of unity” for the fundamental persisting things; and I agree with Armstrong that the account must be a causal one. If the friends of temporal parts are to use a conception of immanent causation to answer questions about diachronic identity, they cannot rest content with Johnson’s definition of immanent causation as a causal relation among stages of the same persisting thing, where the notion of a persisting thing goes unexplicated. For it is precisely the conditions under which stages constitute a single persisting thing that the friends of temporal parts must spell out in terms of immanent causation. My aim in this paper is to offer the friends of temporal parts a species of causation that will serve their purposes.

In section III, I explain what I mean by a “fundamental persisting thing”—namely, a homeomerous substance. In section IV, I show that the friends of temporal parts owe us a causal theory of the persistence of such things, and describe the form such a theory must take. Section V is taken up with stage-setting for the formal statement of the theory to follow. To make any headway, some theory of events and of causation must be adopted. Then, in sections VI and VII, I develop necessary and sufficient conditions for a pair of stages to belong to a single persisting homeomerous substance. Finally, I suggest that an analogue of the necessary condition should be accepted even by those who reject temporal parts in favor of “enduring things”; there is, however, no pressure on endurantists to provide full-fledged necessary and sufficient conditions for persistence. The final section includes a few remarks concerning the empirical question of whether there are in fact any persisting homeomerous substances.

III. Fundamental things

The category of the most fundamental persisting things can be approached through what I have elsewhere called “the theory of masses”.²¹ A theory of masses is an account of the nature of the referents of “concrete mass terms” as they occur in descriptive phrases like “The water in Heraclitus’s tub” or “the gold in this ring”. A concrete mass term satisfies the syntactic criteria for mass terms (mass terms always take singular verbs, cannot occur with numerals, admit determiners like “much” and “little” rather than “few” and “many”, and so on²²), but further-

more only applies to things that can be straightforwardly “heaped together” to make larger entities of the same kind. Tyler Burge demarcates the class of concrete mass terms in this way:²³

(D1) “*K*” is a concrete mass term =_{df} “*K*” satisfies the syntactic criteria for mass terms, and “Necessarily, any sum of parts that are *K* is *K*” is true.

Burge’s definition depends on the idea that mereological talk does not really make sense when applied to abstract mass terms, like “happiness”. My happiness and your happiness does not have a sum which is itself some happiness.

As Helen Morris Cartwright has made clear, an unstressed “some” functions as a kind of indefinite article for mass terms. So a theory of masses will explain what we are talking about when we refer to the water in the tub or the gold in the ring; or when we say that some water in the tub came from the river, or that some gold in the ring was once part of a brooch.

Certain theories of masses would regard “the water in the tub” as referring to a single physical object, namely the *mereological sum* of all the water molecules in the tub. Others would take this expression to refer to the *set* of these water molecules, or to be a plural expression (like “Tom, Dick, and Harry”) which refers to all the molecules without actually denoting a *set* of any kind. But there is a certain sort of mass term *K* which, in contexts like “the *K*” and “some *K*”, must be taken to refer to a kind of physical object: these are the mass terms that refer to *homeomerous* mass-kinds.²⁴

The homeomerous is distinguished from the heteromerous in the following way: Every mass of heteromerous stuff-kind *K* has parts that are not themselves masses of *K*; while a homeomerous stuff-kind *K* is “*K* through-and-through”—every proper part is itself a mass of *K*, so that “*K*” is what Leonard and Goodman call a “dissective predicate”.²⁵

There are two ways for a stuff-kind to be homeomerous. If there were a stuff-kind *K* which consisted of partless atoms—absolutely unextended Boscovichian simples, for example,—then *K* would be a homeomerous stuff-kind. Every heap of *K*-atoms would be a mass of *K*, and every part of the heap would be a mass of *K*—right down to the limiting case of each single (partless) particle. If a homeomerous stuff-kind *K* is like Aristotelian matter, however, it has no *K*-atomic decomposition; it is a hunk of “atomless gunk”,²⁶ infinitely divisible, each proper part having a proper part that is itself some *K*.

It can be shown that, if everything were not constituted, ultimately, by masses belonging to homeomerous stuff-kinds, then an “Oriental Boxes theory of matter” would be true—molecules constituted by atoms, atoms by protons and electrons and neutrons, these made out of quarks, quarks made out of some distinct things, call them “darks”, and so forth, *ad* literally *infinitum*.²⁷ Perhaps the Oriental Boxes hypothesis escapes inconsistency; but it is surely not an attractive picture—far more natural to assume that the constitution relation “bottoms out” somewhere at masses of one or more kinds of homeomerous stuff. In the sequel,

substitutions for the schematic letter “*K*” are restricted to mass terms for homeomerous substances.

Masses are very well-behaved, mereologically speaking. A mass of a certain kind of stuff must include all and only the same masses of that kind among its parts for as long as it exists:

- (A1) If *x* is a mass of *K*, then, for every *y* such that *y* is a mass of *K*, *y* is a part of *x* if and only if it always was and always will be the case that, if *x* exists, then *y* is a part of *x*.

Mereological essentialism is, then, roughly true for masses of *K*.

I have argued at length elsewhere for this theory of ultimate or homeomerous masses, and so shall presuppose it in what follows. But one might wonder whether the restriction of consideration to just homeomerous stuffs greatly diminishes the interest of the analysis of immanent causation. After all, given certain results from quantum theory, it might seem that the only homeomerous substances there are neither persist through time nor have stages that are immanent-causally connected. Although lacking the competence to speak decisively to this latter claim (which I nonetheless consider briefly in the concluding section), I offer some reasons to think that a generic notion of immanent causation for homeomerous substances is of considerable importance.

First of all, as I suggested above, it may well be that in the case of a more complex, structured entity (e.g., a car or a human being), a causal constraint will *follow from* but not be an *independent part of* the criterion of diachronic identity for that specific kind. If this is the case, then the only distinctive role for immanent causation to play in the giving of “criteria of identity” will be at the most fundamental level of the essentially structureless substances—namely, the homeomerous masses. Having a criterion of identity for such things would at least add some content to the claim that the most fundamental particles do not persist.

Furthermore, even if it were to turn out that there are no persisting fundamental substances to which the analysis applies, few would deny the bare *possibility* of persisting homeomerous stuffs. And it is precisely this bare possibility that has been thought to pose severe problems for the doctrine of temporal parts—problems which can only, it appears, be solved by appeal to a notion of immanent causation appropriate to such substances. C. D. Broad, Saul Kripke, and D. M. Armstrong, for example, consider puzzles that arise if a volume of perfectly homogeneous fluid or a solid sphere made of a homogeneous substance were to consist of temporal parts.²⁸ How can the difference between a rotating sphere and a stationary one be made out, if each instantaneous temporal stage of each sphere is intrinsically just like every other? The answer must, it seems, lie in differences in the causal relations among the stages of the various portions of the spheres. In the rotating sphere, a stage of its Eastern hemisphere will be immanent-causally connected to a series of later hemisphere-stages that twist around in a smooth path so that, when half of the time of rotation has elapsed, the series includes a

Western hemisphere-stage. In the stationary sphere, an Eastern hemisphere-stage will be immanent-causally connected only with later Eastern hemisphere-stages.²⁹

So far, those who appeal to immanent causation to solve this problem have left the notion largely unexplicated. Armstrong, for example, says "I am far from thinking that I have adequately characterized the particular nature of the causal relation which holds between different phases of the same thing."³⁰ And Sydney Shoemaker has an argument (from his rather controversial theory of properties) intended to show that there is no hope "of defining the notion of immanent causality, or the required notion of an 'appropriate' causal connection between thing stages, without the use of the notion of persistence".³¹ Clearly, this would be bad news for the friends of temporal parts. Given the problems posed by homogeneous substances for the doctrine of temporal parts, the category for which I believe a generic notion of immanent causation can be tailored is precisely the category for which one is most urgently needed.

The question I will try to answer is: What relationships among stages of homeomerous stuff-kinds are required to unite them into a single persisting mass of stuff belonging to that kind? If the causal theory of identity is true, causal connections will play a prominent role. But before offering a concrete proposal, I shall provide a reason for thinking that, if the doctrine of temporal parts is true, there *must be* an answer to this question.

IV. Why there must be "criteria of diachronic identity" for masses

If you accept the doctrine of temporal parts, then you must also accept that there are informative necessary and sufficient conditions which determine when a set of temporal parts qualifies as a persisting mass of homeomerous *K*. Why? Because of the plausibility of *mereological supervenience*, the thesis that the existence and nature of a whole is determined by the fact that its parts exist and are interrelated in certain ways.

My argument will proceed in this way: Since the properties of and relations among parts determine the intrinsic properties of wholes, and since being a persisting mass of *K* is intrinsic to things that have it, then—on a temporal parts account—being a persisting mass of *K* must supervene on the properties of and relations among the momentary temporal parts of any given mass of *K*. And the supervenience of *being some persisting K* implies that there is a necessary and sufficient condition of some sort that can be given in terms of intrinsic properties of momentary stages and relations among them.³²

Intrinsic properties are those properties the possession of which implies nothing about goings-on elsewhere or elsewhen. They are the properties a thing has just in virtue of what it is like in itself now, as opposed to those that it has in virtue of its relations to other things, or to the future or past.³³ The idea is simple enough, but improving upon this rough-and-ready characterization requires a good deal of "chisholming".³⁴ So I consign definitions (D2) through (D5), which comprise my efforts at clarification, to appendix A, below.

To express the dependence of wholes upon parts, I need two disjoint domains of objects: a set of parts and potential parts, D^p ; and a set of wholes D^w , which includes all and only the wholes made from the members of D^p . I also need two families of properties associated with these domains. Let the family of properties and relations B include all and only intrinsic properties exemplifiable by the members of D^p , spatiotemporal and causal relations that may hold among the members of D^p , and properties that represent the “generalizations” of these spatiotemporal and causal relations—where a relational expression is “generalized” by eliminating a term through existential quantification. *Being 2 miles from a burning barn and being caused by a fire*, where these do not imply relations to any specific barn or fire, are generalizations of spatial and causal relations. The importance of including such properties in the supervenience base will soon become clear. Let the family of properties A include just intrinsic properties and the general “kind” or “sortal” properties that are exemplified by members of D^w (as noted below, intrinsic properties, if any, that are “true emergents” will also need to be excluded from A).

Now the thesis of mereological supervenience I wish to maintain can be expressed as follows, where the “ S ”s are sets of members of D^p , and “ x ”, “ y ”, etc. range over D^w , and distributions of B -properties over sets S and S^* are *indiscernible* just in case there is a one-to-one function f from S (and its subsets) onto S^* (and its subsets) such that, for any x and $\{y, z\}$ in S , and any B -property P and B -relation R , x has P if and only if fx has P , and $\{y, z\}$ is in the extension of R if and only if $f\{y, z\}$ is in the extension of R ³⁵:

- (MS) For any S and S^* and worlds w and w^* , if S in w is indiscernible from S^* in w^* with respect to the distribution of B -properties and relations; then, if there is an x in w constituted by S , then there is a y in w^* constituted by S^* , and x in w is indiscernible from y in w^* with respect to A -properties.

This holds, I believe, for any pair of domains consisting of parts and wholes made out of those parts, as defined above. *Perhaps* some allowance has to be made for truly emergent intrinsic properties of wholes, if there can be such things, properties that could come and go independently of any particular goings-on at the level of parts. True emergents must be excluded from among the A -properties. But surely such features as shape, color, disposition to move or change shape, and—most importantly for my purposes—general *kind* of object, should supervene in this way.

Note that, if I had left those properties I called “generalized relations” out of the supervenience base, there would have been resistance from some quarters. One reason for requiring the inclusion of relations has to do with a set of parts that *would* have constituted an object of a certain kind if they were not part of a larger set of parts that already constitutes an object of that kind. Consider the set of cells that make up my body now, and the set that will make up my body after I have lost

several flakes of skin. The latter set will constitute a human being, but—so many would say—it does not do so now. However, it seems that its members now and its members at the time it constitutes all of me may be indiscernible with respect to just the intrinsic properties and real, *ungeneralized* relations in *B* which hold among them. Once generalized spatial and causal relations are let into the supervenience base, however, the two cases are distinguishable. At present, the set of cells has members attached to some other skin cells not among its members; later, none of its members will be so attached. And this difference seems relevant to whether or not the set constitutes a single human being.³⁶ Secondly, there are worries about fission and fusion. If the sets of parts in question include *temporal* parts, then those who maintain “best candidate” or “closest continuer” criteria of identity would allege that the presence or absence of rival candidates must be taken into account in the determination of whether a set of parts constitutes an object of a given kind.

Of course there are those who oppose bringing these sorts of extrinsic considerations into play. Geach says that Tibbles-minus-1,000-hairs is a cat even with the hairs still attached³⁷; Chisholm would probably say that, counting tables strictly and philosophically, we must admit that there are many tables already present “inside” the largest table—they are simply “uncovered” when bits of its surface are chipped away.³⁸ And opposition to “best candidate” theories of persistence through time is even more widespread. Note, however, that such philosophers should have no quarrel with (MS); they simply think that it is unnecessary to add the “generalized relations” to the supervenience base. They are committed to an even stronger version of mereological supervenience than is necessary for my purposes.³⁹

Next I introduce the “set-theoretic complete specifications” with respect to *B*, which are specific ways of having the properties and relations in *B* distributed over the various subsets of *D^p*.

- (D6) *F* is a set-theoretic complete specification with respect to *B* =_{df} *F* is a property of sets which is such that, necessarily, for any sets *S* and *S**, *S* and *S** both have *F* if and only if they are indiscernible with respect to the distribution of *B*-properties and *B*-relations.

The complete specifications are defined in such a way that sets *S* and *S** have the same one if and only if there is a one-to-one function from *S* onto *S** that matches a member (pair) in the one with a member (pair) in the other just in case they have the same *B*-properties (stand in the same *B*-relations). Now I assume that every subset of *D^p* has a set-theoretic complete specification *F*. Given this assumption, mereological supervenience has an equivalent formulation in terms of set-theoretic complete specifications:

- (MS*) For any *S* and *S** and worlds *w* and *w**, if there is an *x* such that *S* constitutes *x* in *w*, then, if *S* in *w* has the same set-theoretic complete

specification F as S^* in w^* , then there is a y such that S^* constitutes y in w^* , and x in w is indiscernible from y in w^* with respect to A -properties.

I expect that temporal parts theorists will accept the thesis of mereological supervenience when D'' is the set of momentary stages of the sort that can make up persisting masses of K , and D^w is the set of persisting masses of K themselves. It is eminently plausible to suppose that wholes depend for their existence and general features upon the nature of and relations among their parts in the way made explicit by (MS) and (MS*). And the temporal parts theorist is committed to the theory that temporally extended things are made of temporal parts just as spatial wholes are made of spatial parts; and so the kind of part-whole dependence that holds elsewhere should hold here as well. Could there be two series of stages, indiscernible with respect to intrinsic properties and causal and spatio-temporal relations (including generalized ones), yet differing in that one is some persisting K -stuff and the other is not? I do not believe that the temporal parts theorist can in good conscience allow for this possibility; to do so would be tantamount to admitting that a mass of persisting K is something over and above the sum of its temporal parts, suitably related.

Given that (MS*) holds relative to these domains and the appropriate sub- and supervenient properties, it can be shown that there are something like “informative criteria of diachronic unity” for masses of K . Consider the set F^* of all the set-theoretic complete specifications with respect to B . There is a subset of F^* which includes each property in F^* which is such that, necessarily, a set of temporal stages has it if and only if the set constitutes a persisting mass of K . The disjunction of each such property provides a necessary and sufficient condition for a series of stages to constitute a persisting mass of K .

Although most likely infinite in length (unless the domain of parts and the set of B -properties and B -relations is finite), the condition such a disjunction provides is “informative” at least in this weak sense: it does not make use of any properties or relations that could only be exemplified by some persisting K -stuff. It only describes how things are with respect to instantaneous stages of the sort that could be linked together to form some persisting K -stuff—how these stages are intrinsically, and how they are causally and spatiotemporally interrelated.⁴⁰ True, this does not show that the condition need be informative in the sense that it could be a piece of information graspable by a finite mind. But conversely, it should not be assumed that the condition *could* not be grasped by human beings merely because it is equivalent to an infinite disjunction. After all, *every* condition is equivalent to an infinite disjunction. There may be some relatively simple way of describing what each of these disjuncts have in common; indeed I shall attempt to do so here. To complain that there *might* be no way to describe the condition in finite terms is simple defeatism or laziness—a reluctance to engage in “honest toil”. It is a conjecture to which one should be forced only after countless failed attempts to formulate criteria of diachronic unity for masses of K in

terms of intrinsic properties of, and spatiotemporal and causal relations among, momentary stages of *K*-stuff.

(A parallel argument can be marshaled against those who say that, although human beings are macroscopic material objects, personal identity is “brute”—that is, there can be no informative criteria of diachronic identity.⁴¹ Just let D^p consist of individual cells, and D^w of human beings; let *B* include the intrinsic properties of and spatiotemporal and causal relations holding among cells, and *A* the intrinsic properties of human beings. If human beings are “gross physical objects” and mereological supervenience is true, then there will inevitably be informative necessary truths about the persistence conditions of human beings—the only question is whether they are too complex for us to figure out.)

What has been proved is that—given the doctrine of temporal parts, and of the dependence of wholes on parts—being some persisting *K* is “nothing over and above” being a series of momentary stages having certain intrinsic properties and standing in the right sorts of causal and spatiotemporal relations. Surely anyone who agrees to this owes us some account of the general nature of these properties and relations.

V. The metaphysical framework: a theory of events and causation

Since there can be little in the way of intrinsic structure that must be preserved in order for some homeomerous stuff to persist (there being little structure present), the only promising places to look for criteria of diachronic unity for such things is in the neighborhood of spatiotemporal and causal relations among the stages. In section II, I rehearsed some of the reasons that have recently been given for the primacy of causal relations over spatiotemporal continuity in the explication of criteria of diachronic unity. I take it that these considerations show that a certain sort of causal dependence of later momentary stages of *K*-stuff upon earlier such stages must provide the “cement” which binds the stages together to form some persisting *K*. But how to explicate this causal dependence?

I cannot see any way forward without the adoption of some positive account of the nature of causation and of causal relata. Here I advance a quite unoriginal account of causal dependence in terms of the nomic subsumption of events. This sort of theory is familiar enough, although my version has a few odd wrinkles. But the general strategy behind my analysis of immanent causation could be carried out, I believe, in any well-developed theory of causation. To make this claim more plausible, I include, as appendix C below, an explication of immanent causation in accordance with the same guiding intuitions but within the context of a very different theory of causation—namely, Ellery Eells’s version of a probability-raising analysis.

I am assuming that the “stages” which require welding are instantaneous temporal parts; later, I show how to translate some of my results into an endurantist framework, by construing “stages” as momentary events involving an enduring subject’s exemplifying all its present intrinsic properties. For even if one

rejects temporal parts, one must admit that, in the case of a persisting mass of stuff, its existing now and having the characteristics it does must be dependent at least in part upon its having existed and having been the way it was moments ago. Why is a statue made of some *K* six feet tall right at this moment? One explanation for this fact is: Because it was six feet tall during a period of time leading up to this moment, and no outside forces were acting to alter its shape. Is this explanation really a causal one? Well, if there were bizarre laws of nature or none at all, and objects changed size at random in the absence of external forces, then the explanation would be no explanation. And surely an explanation that depends for its force on laws of nature must be implicitly causal.

The basic principle behind my analysis is this: the way a persisting mass of *K* is, intrinsically, at a time must be caused, in part, by the way it was intrinsically at earlier times. This might be described as the principle that a persisting mass of *K* must be “self-perpetuating”; or that its “material properties” must be “propagating in unison”.⁴² Of course its earlier intrinsic nature will not typically be the complete determiner of all its properties—there may, and usually will, be outside influences working on the thing as well. But the earlier intrinsic properties exemplified by a persisting thing cannot be causally irrelevant to its later ones.

I want to say, then, that—in the case of some persisting *K*—a present exemplification of an intrinsic property by a stage of *K*-stuff is always caused, *in part*, by earlier exemplifications of intrinsic properties on the part of stages of *K*-stuff that belong to the same mass of *K*. Obviously, then, I need some account of what it is for an exemplification of a property to be a *partial cause* of another exemplification of a property. Within a nomic subsumption theory of causation, being a partial cause goes over naturally into “being an ineliminable part of a causally sufficient condition” or “being an essential part of the ‘total cause’”.

I favor a version of the property-exemplification approach to events. As Jaegwon Kim indicates, a property-exemplification theory seems necessary for the explication of causation in terms of the subsumption of events by laws of nature.⁴³ Kim’s events are structured complexes including as constituents an object, a property it exemplifies, and the time of exemplification. Chisholm advances a similar theory, but omits times as constituents for roughly relationist reasons.⁴⁴ In Chisholm’s property-exemplification theory, events have a characteristic structure; the canonical name for a given event has the form “*x*-having-*F*”, where “*x*” refers to the “substrate” of the event (the thing that exemplifies the property), and “*F*” provides the “content” of the event (“*F*” connotes the property exemplified). I depart from Chisholm’s recent theory only in supposing that events are *recurrent*. As I have argued elsewhere, to suppose otherwise leads to an unsatisfactory existentialism with respect to Chisholm’s events.⁴⁵ Thus, when substrate *a* exemplifies *F* for awhile, stops, and then exemplifies *F* again, there is a single event of *a*-having-*F* which exists for awhile, ceases to be, and then comes back into existence. The recurrability of my events should not be taken as a sign that they are really some kind of abstract object—like propositions that exist whether true or false, or states of affairs that exist whether or not they “obtain”. Those who

think that a disassembled watch ceases to exist until it is reassembled are not committed to the view that watches are really abstract objects. I also hasten to point out that the recurrable nature of my events plays no real role in the theory of immanent causation I develop. Kim's non-recurrable events would have served my purposes just as well. But, with Chisholm, I seek to avoid reference to particular times when speaking most strictly and philosophically. And so I am reluctant to adopt Kim's theory of events according to which events are structured complexes containing times among their constituents.

For obvious reasons,⁴⁶ a theory of recurrable events requires that causal relations between events be temporally relativized. *a*-having-*F* causes *b*-having-*G* not *simpliciter*, but relative to a certain period of time *T*. For example, the trigger's being pulled (an event which happens again and again) now causes the gun's firing (another event which happens again and again); but the former does not now cause *every* subsequent appearance of the gun-firing event—only, in this case, the *next* one, which happens a fraction of a second after the firing that now exists. To capture this sort of distinction without recourse to names for times or quantification over times, I make use of distinctions of tense, and relativize the *now-causing* relation to an "interval" *T* which can be either a particular number of time-units (e.g., five minutes, or one second), zero (in the case of simultaneous causation), or one *instant* (in the case of an event which now causes another to occur during a future interval that is open on its earlier side and has the present instant as its earliest boundary).⁴⁷ So cause and effect may be simultaneous (i.e., *T* = 0) or temporally contiguous (right after the present instant, the case in which *T* = 1 instant), or separated by a temporal interval (*x*-having-*F* causes *y*-having-*G* in 1 minute, for example). This is not to say that all these kinds of causation actually occur or are even metaphysically possible; I simply show how the relativization of causal relations to any period of time can be effected within a scheme of recurring events.

By my lights, there is really only one promising strategy for explicating causal relations in terms of laws of nature: The Dretske-Tooley-Armstrong approach, which insists that laws of nature are more than just true generalizations.⁴⁸ On this view, a law of nature is the holding of a special kind of necessitating relation between the properties involved in the law; this relation is what makes the true generalizations come about, what gives them their nomic strength, what enables them to support counterfactuals. Furthermore, given these sorts of laws, not all true generalizations that support counterfactuals need be *real* laws. Some just follow from the real laws, or from the real laws given certain actual conditions; and their nomic force is inherited from the laws that entail them.

There are, of course, serious objections to be faced by proponents of the Dretske-Tooley-Armstrong account of laws.⁴⁹ But I take it that, if a nomic subsumption theory of causal relations can be made to work, it will have to appeal to a strong theory of laws along these lines.

Here, then, is a proposal for the explication of "causal sufficiency" in terms of subsumption by law. It is very much in the spirit of analyses found in Foster and Kim.⁵⁰

- (D7) *x*-having-*F* is *causally sufficient* for *y*-having-*G* in $T =_{df}$ for some relation *R*, (1) it is a law of nature that for every event *e* with *F* as content, there is just one event with *G* as content that occurs in *T* and that is related to it by *R*; and (2) *y*-having-*G* occurs in *T*, and is *R*-related to *x*-having-*F*.

Instances of immanent causation involve events that have momentary stages of a thing for substrate, and these events must cause later events having later stages as substrates. Recall that one of Hume's strictures on the causal relation was that cause and effect be spatiotemporally contiguous. Although I do not assume this Humean principle in full generality, surely, in normal cases of a persisting thing, a stage causes later stages that come "right after it"—that is, the causal contribution of a given stage should not "skip over" any stages to hit a later stage. But the problem, of course, is that—assuming the continuity of time—there is no *next stage*. So what exactly can be caused by an event with a given momentary stage as substrate? Obviously, analogous questions may be posed for a given stage taken as effect: *Which* earlier stage caused *it*?

Russell thought that, given the compactness of the time-series, he could prove that contiguity of cause and effect is impossible. However, his "proof" depends upon the assumption that, for each cause, there must be a single effect; and for each effect, a single cause.⁵¹ But why suppose that? It is not, I would argue, implied by our everyday ascriptions of causal dependencies. I may single out the drop in temperature as "the cause" of the burst radiator, without denying the accuracy of the mechanic's claim that my failure to add anti-freeze was "the cause". We can only ask, "What was *the cause*?" within the context of shared assumptions about what to count as "mere" background conditions, what environmental factors should be taken for granted, and so on. These assumptions are quite conventional, and easily shifted. Nor is it at all natural to make Russell's assumption within the metaphysics of causation to which I appeal here. On the contrary, a single deterministically sufficient condition will surely be a sufficient condition for *many* events happening at slightly different subsequent times. For instance, events happening in my office now are, I expect, causally sufficient for the table in the center of the room to continue to support the books on it for at least the next few milliseconds; in other words, the laws of nature rule out the possibility of a force originating from outside the boundaries of the room that could intrude and upset the table in less time than that. So the absence of such forces within the confines of my office right now is causally sufficient for the continued stability of the table throughout some very short period. Thus the stability of the table at each instant during this period can be causally explained by the conditions in my office now. And any event that is an essential part of the presently existing causally sufficient conditions should qualify as *a cause* (and, given the right conversational context, "the cause") of the table's stability throughout the whole of this subsequent period. Shortly, I shall spell out what it means for an event *e* to be an "essential part" of a causally sufficient condition for another event.

Not only is there typically more than one effect per sufficient condition; there are also many—larger and smaller, more and less comprehensive—sufficient conditions for one and the same effect. In general, smaller ones suffice for the existence of only the most temporally nearby events, while larger ones suffice for events stretching far into the future. In any case, the way the world is in the immediate vicinity of the region occupied by a thing should include enough events to necessitate the subsequent existence of a whole stretch of instantaneous stages of that thing. Does that mean that events involving earlier stages in such a stretch are not causally involved in the production of later ones; that their causal contributions have been preempted by the existence of the earlier causally sufficient condition for the whole stretch? No; for there can be more than one causally sufficient condition for something, and more than one cause of it as well. Events involving these later stages are also essential parts of causally sufficient conditions for the subsequent stages, and have just as much right to count as causes as an event that was part of an earlier sufficient condition.

When one condition *c* is causally sufficient for a subsequent condition *d*, and both are causally sufficient for a still later event *e*, events that are essential parts of both *c* and *d* can rightly be said to be causes of *e*. What we want to say is that the causal contribution of *c* and its essential parts “passes through” *d* to bring about *e*. Russell’s contiguity argument has nothing to say against this picture; its very possibility is ruled out by his unargued assumption that it is an analytic part of the notion of cause and effect that there be exactly one cause for each effect and vice versa. But, as noted earlier, familiar patterns of reasoning about causes do not bear out his claim; and so the fact that the present theory of causation does not presuppose it simply counts in its favor.

I take it that all causal conditions are in the same broad category of causal relata as are events; and that the *substrate* of any sufficient causal condition can be construed as an *aggregate* of all the individual things involved in it, and its *content* as a property of this aggregate. Given these assumptions, an event involving the exemplification of an intrinsic property by a momentary stage will be a *part* of certain sufficient causal conditions for events involving subsequent stages in the following sense:⁵²

- (D8) Event *e* is a *part* of event *h* =_{df} there is a property *G* and relation *R* which are necessarily such that: (1) if something exemplifies the content of *h*, then something exemplifies *G*; (2) for any *x* that has the content of *h*, there is a *y* such that *y* is a part of *x*, *y* has *G*, and *x* is *R*-related to *y*; (3) the substrate of *e* is a part of the substrate of *h*; (4) the substrate of *e* is related by *R* to the substrate of *h*; and (5) the content of *e* is *G*.

In clause (3) (and elsewhere), I use “part” in the philosophical sense, in which it is not equivalent to “proper part”; so it turns out, for example, that *my running* qualifies as a part of *my running swiftly*, even though the substrate of the former is not a *proper* part of the substrate of the latter.

Now I can make clear what is required for an event to be an “essential part” of a causally sufficient condition for another event, and so for it to deserve the designation “partial cause” of that event. To make allowance for the possibility of overdetermination, I do not insist that an event is a partial cause just in case it is a part of *every* presently existing causally sufficient condition for the given effect. The parts of a presently existing causally sufficient condition g that are essential to the production of the effect are, rather, those which appear as parts of every presently existing event that is both a part of g (including g itself) and is a causally sufficient condition for the effect. Furthermore, to circumvent problems posed by preemption, I insist that a partial cause c be a part of a sufficient condition f that remains operative throughout the period leading up to the effect—that is, at each subsequent time when there *is* a sufficient condition for the effect, there must be a sufficient condition i that is itself caused by f ; and c must have been part of any part of f that was sufficient for i .

- (D9) c is a partial cause of e in $T =_{df}$ there is at least one presently existing event f such that: (1) f is causally sufficient for e in T ; (2) for every event g such that g is causally sufficient for e in T ; and g is a part of f , c is a part of g ; and (3) for every T^* less than T , if, in T^* , there is a h such that h is causally sufficient for e in T -minus- T^* , then (a) there is a i which is such that, in T^* , i is causally sufficient for e in T -minus- T^* ; (b) f is causally sufficient for i in T^* ; and (c) for every event g such that g is causally sufficient for i in T^* and g is a part of f , c is a part of g .

It is notoriously difficult to free an analysis of causation from problems of preemptive causation and overdetermination; new counterexamples have a way of cropping up each time an epicycle is added to eliminate the old ones. I believe, however, that the above account allows two events that are parts of distinct, overdetermining causally sufficient conditions to *both* qualify as partial causes, as long as neither sufficient condition preempts the other before the effect occurs.

VI. The analysis of immanent causation

With a metaphysical framework for causation in place, I can spell out the precise way in which earlier stages of a mass of K must be partial causes of later stages of the same mass of K . Clearly, if some K -stuff persists, its earlier stages must be involved in determining what the later stages are like. In particular, events having earlier stages as substrates must help to determine what intrinsic properties are possessed by later stages. This thesis was advanced by Lotze and Johnson. Both held that, in Johnson’s words, “any concretely described causal process must be analysed into a conjunction of transeunt and immanent causality”.⁵³ Here is Lotze’s more formal statement of the same idea (in which “ a ” and “ b ” are continuants, and “ a ” is a state or event that happens to a):

If a or a is to act on b , b must in all cases be differently affected by the existence of a and by its non-existence. The 'transeunt' action of a on b would thus lead back to an operation 'immanent' in b For the present we satisfy ourselves with the reflection that anything which b is to experience through the action of a must result from the conflux of two principles of motion; from that which a ordains or strives to bring about and from that which b , either in self-maintenance or self-transformation, would seek to produce, if a were not.⁵⁴

Lotze is claiming that, in every case of an object causing effects in other things, the affected objects must be more than "empty receptacles for effects with the form and amount of which they have nothing to do."

As we have already seen, everything which we can properly call a receptivity consists, not in an absence of any nature of a thing's own, but in the active presence of determinate properties, which alone make it possible for the receptive element to take up into itself the impressions tendered to it and to convert them into states of its own.⁵⁵

Suppose a certain effect is caused transeuntly in a by another object b . If the "determinate properties" of a "would contribute no more to [the] realisation [of the effect] by their existence than by their non-existence", then "instead of something being *wrought* by the cause, it would rather be created by it in that peculiar sense in which, according to a common but singular usage, we talk of a creation out of nothing."⁵⁶ And again:

No thing is passive or receptive in the sense of its being possible for it to take to itself any ready-made state from without as an accession to its nature. For everything which is supposed to arise in it as a state, there is some essential and indispensable co-operating condition in its own nature. It is only jointly with this condition that an external impact can form the sufficient reason which determines the kind and form of the resulting change.⁵⁷

In agreement with Lotze and Johnson, then, I insist that every prior causally sufficient condition for an event involving a given stage of K -stuff must (if the mass of K exists at the earlier time in question) have events involving a stage of the same mass among its parts. But it also seems to me that something stronger is required; not just any kind of causal contribution will suffice. The future intrinsic properties of a thing are largely dependent upon the present intrinsic properties of the thing, and the dependencies have to include dependencies between properties *of the same kinds*. For instance, an object's present shape has to be part of any sufficient causal condition that determines immediately subsequent shape properties; its present mass has to be part of any sufficient causal condition determining immediately subsequent mass properties; and so on. This restriction can be stated in terms of Johnson's distinction between *determinates* and *determinables*. Ultimately, I will say that the possession by an object of intrinsic properties fall-

ing under a certain determinable must be caused, in part, by the object's earlier exemplification of intrinsic properties falling under the same determinable.

Johnson introduces the determinate-determinable relation by examples such as the relation between color and redness, and between shape and circularity. Progression from determinable to determinate is always from less to greater specificity; but, unlike the move from genus to species, there is no additional property which, conjoined with the less specific, produces a property equivalent to the more specific.⁵⁸ Brentano had called this phenomenon "one-sided detachability": in some "compound concepts" each part may be "considered by itself" (e.g., "the concept of a red horse", compounded of *being red* and *being a horse*); but concepts like redness "are such that we can separate out only one of their parts"—in this case, *being colored*. "The specific difference" between redness and *being colored* "is the species [redness] itself".⁵⁹

A good deal more can be said about the determinable-determinate relation, and the ways in which it differs from species-genus and other relations of necessitation among properties. Appendix B, below, includes a description of John Searle's penetrating analysis of the determinate-determinable relation; and culminates in (D10), a more precise set of criteria for one property's falling under another as determinate to determinable.

Johnson taught that all things fall into general *categories* which are defined by the determinables which things in the category must possess. Each individual, that is, comes with certain "built-in" determinables, and must always exemplify some determinate or other falling under each of these essential determinables:

To define more explicitly the notion of a continuant, we will assume that any continuant has several modes of existence, or rather modes of manifestation of existence, each of which may theoretically be conceived as a determinable; and according to the nature of this set of determinables, the continuant may be said to belong to one or another category. We assume further that during the period throughout which a continuant exists, every one of its modes is being manifested in some or other of its determinate forms.⁶⁰

I assume, then, with Johnson, that everything falls under certain *essential intrinsic determinables*:

(D11) *D* is an essential intrinsic determinable of $x =_{df} x$ is necessarily such that it always exemplifies some completely intrinsic property⁶¹ or other that is a determinate falling under determinable *D*.

At this point I face a choice between more and less strict requirements concerning the causal contributions of earlier to later determinates under the same determinable. The most lenient requirement is this: Whenever a persisting mass of *K* exemplifies a given sort of intrinsic property falling under one of its essential determinables (whether or not its exemplification represents a change in the object), the causal explanation for its having this property must include either (i)

earlier possession by the object of properties falling under the same determinable, or (ii) at least earlier possession by the object of the determinable itself. The most strict requirement would add that, for every *absolutely* determinate intrinsic property—i.e., every such property that is not itself a determinable with respect to some more precise determinates falling under it—the causal explanation for a mass's having this property must include earlier possession of other absolutely determinate properties falling under the same determinable.

It seems obvious to me that at least the more lenient requirement must be met by a series of stages that are to qualify as a single persisting mass. Surely if a stage of some *K*-stuff has the intrinsic properties it has *entirely* in virtue of "outside forces", with no earlier stages of *K*-stuff involved, then we have a new mass of *K*-stuff; as Lotze says, this would amount to "creation out of nothing". Furthermore, if a present stage has its *mass* caused in part by, say, the *shape* or *color* of an earlier stage but not at all by the *mass* of the earlier stage, nor even by the earlier stage's being of the right sort to *have* a mass, then something has gone wrong.

The more strict requirement says that the precise present mass, shape, etc. must be caused by earlier exemplifications of the most determinate mass-properties, shape-properties, etc. And this, I think, could be questioned. The strict requirement captures the rather appealing notion that any attempt to change a particular intrinsic property of a thing must "work from" the original determinate intrinsic property of that kind which the object possesses; and it is bolstered by the traditional assumption that nature admits no discontinuous changes. But reflection on the following question suggests that this requirement is too strong: Could a mass of *K* persist if one of its determinable properties were altered "from the outside" or "transeuntly" in a way that depended not at all upon the particular determinates falling under that determinable possessed by earlier stages of the mass? This would be analogous to changing the color of a thing by dumping a bucket of thick black paint over it; the object will be black afterwards no matter what color it was originally. On the face of it, I can see no obvious metaphysical impossibility in such a change. Just by virtue of being a homeomerous mass, the substances in question must be able to survive changes of the most radical sort. For a homeomerous mass is homogeneous or made of simples; and its persistence depends only upon the persistence of any parts it has, not upon the preservation of any particular arrangement of those parts. So I shall build only the weaker requirement into my theory of immanent causation, although the stronger one could easily be substituted. Some have argued that only the *infima species* or "absolute" determinates under a given determinable can be causally relevant—because there *are* in fact no determinable properties, only determinable predicates.⁶² If this is right, then the stronger requirement has no rival.

I first define a notion of immanent-causal connection which is such that any stages of the same homeomerous mass must be immanent-causally connected. The definition requires several steps. Since the substrates of the events I am

dealing with are instantaneous stages, I suppress the relativization to a period of time (causing “in T ”) in the definitions below. There can be no ambiguity concerning when one event causes another if both exist for exactly one instant, never to recur.

First, I insure that the causal connection in question subsumes only events the contents of which fall under the same intrinsic determinable:

- (D12) Stage x of a mass of K is an *intrinsic cause* of stage y of a mass of $K =_{\text{df}}$ (1) x and y are temporal stages of masses of K ; and (2) for every essential intrinsic determinable D of masses of K , and every P such that P is a property of y that falls under D , there is an event f with x as substrate and D or a property falling under D as content, and f is a partial cause of y -having- P .

Notice that nothing in the definition of “intrinsic cause” rules out the possibility that one stage might be the intrinsic cause of another even though there is a temporal gap between them. Nor does my approach presuppose either the compactness or the discreteness of time. These possibilities can be left open by the theory of immanent causation, thus allowing for at least the abstract possibility of discontinuously jumping masses of stuff.

In the case of homeomeric K -stuff, every proper part of a stage must itself be a stage of some K -stuff; and if the larger stage is a stage of some stuff that persists, this smaller stage must also be a stage of some stuff that persists—since any gain or loss of some K yields a slightly different mass of K . Consequently, every proper part of a stage must be causally connected to earlier and later K -stages, if it is to be a temporal part of some persisting K . This requirement is met by first defining “proximate” intrinsic causes, and then the ancestral of this relation.

- (D13) Stage x of a mass of K is a *proximate intrinsic cause* of stage y of a mass of $K =_{\text{df}}$ (1) x and y are both stages of masses of K , (2) stage x is an intrinsic cause of stage y , and (3) for every u such that u is a proper part of the substrate of x , there is a v such that: (a) v is a proper part of the substrate of y , and (b) u is an intrinsic cause of v .
- (D14) Stage x of a mass of K is *intrinsically causally connected* to stage y of a mass of $K =_{\text{df}}$ y is a member of some set of stages S which is such that: (1) every member is a stage of a mass of K , (2) x is a member of S , and (3) for all stages u and v , if u is a member of S and v is a proximate intrinsic cause of u , then u is a member of S .

To solve the usual problems of “wayward causal chains” that pass through teletransporters, the minds of deities and demons, etc., I insist that, in a case of immanent-causal connection, whenever two intrinsically causally connected stages

are intrinsically causally connected to a stage that falls temporally between them, then causes of that stage's exemplifying its determinates must, if they are also temporally between the two original stages, have stages as parts that are themselves intrinsically causally connected to all three of the stages. In other words, there cannot be a gap in the existence of a mass of *K* during which there occurs an *independent* cause sufficient *by itself* to "bring the mass back into existence".

- (D15) Stage *x* of a mass of *K* is *immanent-causally connected* to stage *y* of a mass of *K* =_{df} (1) *x* and *y* are intrinsically causally connected stages of masses of *K*; and (2) for any *z* and *u* such that: (a) *z* is temporally between *x* and *y*, (b) *u* is a stage of a mass of *K* that is intrinsically causally connected to *x* or *y*, and (c) *z* is a sufficient causal condition for *u*-having-*P*, where *P* falls under an essential intrinsic determinable of *u*, there is a stage *v* of a mass of *K* that is (i) intrinsically causally connected to *x* and *y*, (ii) part of the substrate of *z*, and (iii) a proximate intrinsic cause of *u*.

"Immanent-causal connection" constitutes an important necessary condition on a series of stages of *K*-stuff qualifying as a persisting mass of *K*:

- (A2) Necessarily, for all *x* and *y* such that *x* and *y* are stages of the same mass-kind *K*, if *x* and *y* are stages of the same mass of *K*, then *x* is immanent-causally connected to *y*.

That it is merely a necessary condition becomes clear upon consideration of the possibilities of fissions and fusions involving masses of stuff.

VII. Eliminating fissions and fusions

A fissioning series of *K*-stages includes a stage which is a proximate intrinsic cause of two *K*-stages neither of which is a proximate intrinsic cause of the other; and two series of *K*-stages fuse when two stages that are not themselves causally connected are both proximate intrinsic causes of a single *K*-stage. In both cases, there are *K*-stages that are immanent-causally connected but which cannot be regarded as stages of the same mass of *K* for the following reason.

The doctrine of mereological supervenience set forth in section III implies that, if two series of *K*-stages have a common set-theoretic complete specification, then the one constitutes a persisting mass of *K* if and only if the other does. In a perfectly symmetrical case of fission or fusion, each of the competing and partially overlapping series will have the same set-theoretic complete specification. Thus, in perfect fission, the original mass either "goes both ways" or "goes neither way". And similarly for perfect fusions: either the two masses survive as one, or both are destroyed in the creation of some new *K*.

There are, correspondingly, two responses to problems of fission and fusion typically adopted by the friends of temporal parts: 1) a "multiple occupancy strat-

egy”, according to which post-fusion or pre-fission temporal parts are shared by two persisting wholes⁶³; and 2) treatment of fission or fusion as destruction for the fissioning individual or fusing pair. I shall show how either response can be coupled with immanent-causal connectedness to provide a plausible necessary and sufficient condition for a series of *K*-stages to constitute a persisting mass of *K*.

To deploy the multiple occupancy strategy, one first needs to define *non-branching* immanent-causal connection. And the kind of non-branching must be of a special sort appropriate to homeomerous stuffs: not only must a non-branching series not include stages of *K*-stuff that are parts of distinct branches resulting from fission, or leading to fusion; but its member-stages must also contain no distinct proper parts that result from the fissioning of part of an earlier stage, or that fuse to form a single part of a subsequent stage. For it must be remembered that no mass of *K* can survive the gain or loss of *any* submass of *K*; so a series of stages will constitute some persisting *K* only if none of its submasses of *K* are lost through fission or fusion.

The relevant notion of non-branching immanent connection is this:

- (D16) Stage *x* of a mass of *K* is *non-branchingly immanent-causally connected* to stage *y* of a mass of *K* =_{df} there is an *S* such that: (1) for all *z*, *z* is a member of *S* only if *z* is a stage of a mass of *K* and is immanent-causally connected to *x* and *y*; and (2) for every *u*, *v*, and *w* that are parts of stages in *S*: (a) if *u* and *v* are both proximate intrinsic causes of *w*, then either *u* is a proximate intrinsic cause of *v* or *v* is a proximate intrinsic cause of *u*; and (b) if *u* is a proximate intrinsic cause of both *v* and *w*, then either *v* is a proximate intrinsic cause of *w* or *w* is a proximate intrinsic cause of *v*.

Now the defender of the multiple occupancy response to problems of fission and fusion can set forth a condition that would appear to be both necessary and sufficient for sameness of a mass of *K*:

- (A3) Necessarily, *x* is a stage of the same mass of *K* as *y* if and only if *x* and *y* are stages of masses of *K* and *x* is non-branchingly immanent-causally connected to *y*.

Those inclined to regard fission and fusion as requiring that something cease to be must take a slightly different route. In a case of fission, one stage of *K*-stuff will be causally responsible for two resulting stages, and not by a part of it causing one and a part causing the other. Each resulting stage is an equally good candidate for being a stage of the same persisting mass of *K* as the original stage; and, since the opponent of fission rejects multiple occupancy, she must say that *neither* stage is a temporal part of some *K* that pre-existed the fission.

She can “pinch off” every series of *K*-stages at the point of fission or fusion in the following way. A notion of “unique immanent-causal connection” may be

defined which rules out the occurrence of branching at any point that falls temporally between a pair of stages so related.

- (D17) Stage x of a mass of K is *uniquely immanent-causally connected* to stage y of a mass of $K =_{\text{df}}$ (1) Stage x of a mass of K is non-branchingly immanent-causally connected to stage y of a mass of K ; and (2) for every u , v , and w that are (a) parts of stages of masses of K immanent-causally connected to x and y , and (b) temporally between x and y , (i) if u is a proximate intrinsic cause of both v and w , then either v is a proximate intrinsic cause of w or w is a proximate intrinsic cause of v ; and (ii) if u and v are both proximate intrinsic causes of w , then either u is a proximate intrinsic cause of v or v is a proximate intrinsic cause of u .

Clause (1) says that x and y must lie on a single branch of immanent-causally connected stages; clause (i) of (2b) implies that every set of stages falling between x and y and immanent-causally connected with them is such that no stage *and no proper part of a stage* in the set is allowed to be a proximate cause of two stages *or proper parts of stages* unless one of those causes the other. Similarly, clause (ii) implies that a pair of stages or parts of stages falling between x and y in this way cannot both be proximate causes of a third unless the causal contribution of the one “passes through” the other. If the K of which x or y is a stage (or any part of that K) were to undergo fission or fusion in the interval between x and y , there would have to occur one of the kinds of “doubling up” of proximate causal relations ruled out by these clauses.

Now the proponent of fission-and-fusion-as-destruction can state her own favored necessary and sufficient condition for stages of K -stuff being part of the same mass of K :

- (A3*) Necessarily, x is a stage of the same mass of K as y if and only if x and y are stages of masses of K , and x is uniquely immanent-causally connected to y .

Depending on her attitude toward fission and fusion, the defender of temporal parts can use either (A3) or (A3*) to answer the demand (for which I argued in section III above) for a criterion of diachronic unity for masses of homeomerous stuff.⁶⁴

VIII. Immanent-causal relations for those who reject temporal parts

Earlier, I said that everyone—temporal parts theorist or not—should recognize the important role immanent-causal connectedness plays in persistence. In particular, the later intrinsic states of a persisting mass of K must be dependent upon earlier intrinsic states in the way indicated by (A2). Even those who deny that persisting things are made up of temporal parts should admit this much; and

so I offer “endurantists” (those who deny that objects persist by means of temporal parts)⁶⁵ the following account of immanent-causal connectedness as a necessary condition for the persistence of homeomerous masses.

Although denying that persisting *objects* have temporal parts, most endurantists would not deny that persisting *events* have temporal parts. Every object has, I assume, something that could be called an “intrinsic history”, an event that lasts just as long as *it* does, and that consists at each moment of the object’s exemplification of all its intrinsic properties at that time. Thus, although an enduring object does not have a present temporal stage, its intrinsic history has a present “temporal event-stage”:

- (D18) *e* is *x*’s present *temporal event-stage* =_{df} *P* is the conjunction of all the intrinsic properties *x* has, and *e* is the event of *x*-having-*P*.

The notion of immanent-causal connection can then be built up in steps analogous to those used within the temporal parts framework above:

- (D12*) Event-stage *x* of a mass of *K* is an *intrinsic cause* of event-stage *y* of a mass of *K* in *T* =_{df} (1) *x* is a present temporal event-stage of a mass *a* of *K*; (2) in *T*, *y* will be a present temporal event-stage of a mass *b* of *K*; and (3) for every *D* such that *D* is an essential intrinsic determinable of masses of *K*, and every *P* such that *P* is a property that falls under *D* and is implied by the content of *y*, there is an event *f* such that: (a) *a* is its substrate and *D* or a property falling under *D* is its content, (b) its content is implied by the content of *x*, and (c) it is a partial cause of *b*-having-*P* in *T*.

- (D13*) Event-stage *x* of a mass of *K* is a *proximate intrinsic cause* in *T* of event-stage *y* of a mass of *K* =_{df} (1) *x* and *y* are both event-stages of masses of *K*, (2) event-stage *x* is an intrinsic cause of event-stage *y* in *T*, and (3) for every *u* such that *u* is a proper part of the substrate of *x*, there will be a *v* such that: (a) *v* is a proper part of the substrate of *y* in *T*, and (b) *u*’s present event-stage is an intrinsic cause in *T* of *v*’s event-stage in *T*.

- (D14*) Event-stage *x* of a mass of *K* is *intrinsically causally connected* to event-stage *y* of a mass of *K* =_{df} *y* is a member of some set of event-stages *S* which is such that: (1) every member is an event-stage of a mass of *K*, (2) *x* is a member of *S*, and (3) for all event-stages *u* and *v*, if *u* is a member of *S* and *v* is a proximate intrinsic cause of *u*, then *u* is a member of *S*.

- (D15*) Event-stage *x* of a mass of *K* is *immanent-causally connected* to event-stage *y* of a mass of *K* =_{df} (1) *x* and *y* are intrinsically causally

connected event-stages of masses of *K*; and (2) for any *z* and *u* such that: (a) *z* is temporally between *x* and *y*, (b) *u* is an event-stage of a mass of *K* that is intrinsically causally connected to *x* or *y*, and (c) *z* is a sufficient causal condition for the substrate of *u*'s having some property implied by the content of *u*, there is an event-stage *v* of a mass of *K* such that: (i) *v* is intrinsically causally connected to *x* and *y*, (ii) the substrate of *v* is part of the substrate of *z*, and (iii) *v* is an intrinsic immanent cause of *u*.

A necessary condition on persistence of homeomerous stuff acceptable to endurantists could then be given this form:

- (A2*) Necessarily, for all *x* and *y* such that *x* and *y* are stages of the same homeomerous mass-kind *K*, if *x* and *y* are stages of the same mass of *K*, then *x* is immanent-causally connected to *y*.

It is important to recognize, however, that endurantists are under no pressure to go further than this, to look for causal conditions both necessary *and sufficient* for the persistence of some homeomerous *K*. The argument of section III for the existence of informative criteria of this stronger sort depended upon the adoption of a temporal parts framework; it depended upon the assumption that a persisting whole is literally made up of, and therefore mereologically supervenient upon, its temporal stages. But the endurantist's temporal stages are *not* literal parts of persisting objects; no purchase is given to the argument for the existence of informative criteria of diachronic unity, since it depended on the assumption that stages *are* literal parts.

The point at which endurantists may well want to exercise their "freedom from criteria" is, rather obviously, in cases of (apparent) fission or fusion. Here a familiar example will help show the plausibility of this move. Suppose that the soul is, as most dualists believe, a nonphysical, simple substance. In that case, it belongs to a homeomerous substance-kind—*soul-stuff*, consisting of individual souls and mereological aggregates of souls; much as, had Boscovich been right, *matter* would have consisted of individual point-sized simples and mereological aggregates of such simples. A dualist might well think, then, that what would happen if someone's brain were split and the two hemispheres transplanted successfully is that the series of "soul-stages" associated with the original body is immanent-causally connected with two series of soul-stages after the operation. (This would be more plausible, surely, than insisting that the operation results in at least one automaton.) If a soul were nothing over and above the sum of its stages, then—given mereological supervenience, and a case of perfect fission—the original soul would *have* to go with both bodies or with neither. But the *endurantist* dualist has further options available to her, simply because she denies that the souls involved are wholes composed of temporal parts. For her, there is a "further fact" beyond those describable in terms of the intrinsic properties of

and interrelationships among soul-stages. There are, in addition, facts about whether the original enduring soul continues to exist after the operation, and whether it is then associated with one half-brain or the other, or with neither.⁶⁶ Since the soul-stages are not literal parts of the persisting person, but only events in the history of an enduring thing, no argument from mereological supervenience forces the dualist into accepting fission-as-death and multiple occupancy as the only alternatives.

IX. Are there any persisting homeomerous substances?

This is a nice question. Quantum theory might be taken to have shown that there are not. The ultimate constituents of matter no longer appear to be like tiny billiard balls, traveling along spatiotemporally continuous paths. They possess both wave-like and particle-like characteristics; and it is impossible to measure at the same time both momentum and position. Perhaps even more surprisingly, the most widely-accepted views about *what* is being measured entail that “one cannot avoid leaving indeterminate the number of particles dealt with”, and that, as a consequence, the particles “are not individuals.”⁶⁷ Erwin Schrödinger describes the conclusions generally drawn from facts about the statistical behavior of fermions and bosons:

No doubt the notion of individuality of pieces of matter dates from time immemorial. I suppose animals must have it in some way, and a dog, when seeking for his ball that has been hidden, displays it very plainly. Science has taken it over as a matter of course. It has refined it so as safely to embrace all cases of apparent disappearance of matter. The idea that a log which burns away first turns into fire, then into ashes and smoke, is not alien to the primitive mind. Science has substantiated it; though the appearance in bulk may change, the ultimate constituents of the matter do not.... Neither [Democritus] nor Dalton doubted that an atom which was originally present in the block of wood is afterwards either in the ashes or in the smoke.

In the new turn of atomism that began with the papers of Heisenberg and of de Broglie in 1925 such an attitude has to be abandoned. ... Now we do observe single particles; we see their tracks in the cloud chamber and in photographic emulsions Yet we must deny the particle the dignity of being an absolutely identifiable individual.⁶⁸

If electrons and quarks are simple, then each electron or quark, and each cloud of electrons or quarks, is a homeomerous mass—some of the fundamental stuff out of which material objects are made. But if there can be no such thing as “having the very same quark or electron again”, then at least these sorts of homeomerous masses do not, strictly speaking, persist through time.

These are hard sayings. It is difficult to believe that the electron that starts a track in a cloud chamber cannot properly be said to be the very same electron that finishes the track. And, naturally enough, a number of scientists and philosophers of science have suggested ways to square quantum mechanics with truly persist-

ing particles.⁶⁹ There are powerful arguments for the conclusion that the facts of quantum mechanics show that no fermion or boson detected at one time can be identified with one that is present on a later occasion; but even the best of them are considerably less than coercive, as their own proponents sometimes admit.⁷⁰

But perhaps Schrödinger is right. I wish only to advance three claims here: (1) if there were evidence of immanent-causal connectedness among stages of these particles, then the quantum-statistical evidence against persistence would be overturned; (2) even if the fundamental particles governed by quantum statistics do not persist, there *may* still be “emergent” homeomerous substances which are dependent upon these non-persisting particles but not literally composed of them; and (3) even in the absence of any persisting homeomerous substances, the analysis of immanent causation has important consequences for the defense of the doctrine of temporal parts.

The first point is important for the following reason: if the evidence usually advanced for the non-persistence of particles were not in conflict with my proposed immanent-causal criteria of identity for such things, then doubt would be thrown on the adequacy of my account. Either the usual evidence from quantum statistics does not in fact point toward non-persistence, or my criterion is faulty. I shall show that, assuming the “fission-as-destruction” criterion of identity, the evidence for non-persistence *would* be in conflict with evidence for persistence derived from immanent-causal connectedness. On the other hand, assuming the multiple occupancy version of the theory, it will turn out that the evidence from quantum statistics no longer points unequivocally toward non-persistence.

Putting the matter very abstractly, the quantum-statistical evidence for non-persistence comes to something like this: Suppose there are two “cells” or incompatible states C^1 and C^2 , which two particles a and b must occupy. There would seem to be four possible state-structures for the system: (i) a and b are both in C^1 , (ii) a and b are both in C^2 , (iii) a is in C^1 and b is in C^2 , and (iv) b is in C^1 and a is in C^2 . In the actual cases that give rise to the evidence, cases (iii) and (iv) are physically indistinguishable and, more puzzlingly, the chance of *one or the other's* occurring is equal to the probability associated with *each* of (i)'s occurring and (ii)'s occurring. It appears that “nature” does not distinguish between two ostensibly distinct states of such a system if the only differences between the states are that the “labels” for the particles are switched. It is a short step to the conclusion that, where nature fails to make distinctions, there are none to be made. The application of the same “labels” to such particles at different times cannot correspond (or, for that matter, fail to correspond) to any underlying fact about the identity of the particles in question.⁷¹

But suppose that evidence of immanent-causal connectedness among stages of such particles were somehow produced. On the “fission-as-destruction” account, for such evidence to show that there *are* persisting particles, intrinsic states of a particle at one time must appear to be causing *just one* of the two later particles to be in intrinsic states of the same sort; for if the stages of the one particle seemed to be “intrinsic causes” of subsequent stages of *both* particles, then we would have evidence of fission, not of the association of the earlier

particle with just one subsequent particle. Having additional evidence of this sort would enlarge our original two cell system. Although the probability of the disjunctive outcome “either (iii) or (iv)” would still have the same probability as each of (i) and (ii) alone, the enlarged system would require that (iii) and (iv) be distinguished nonetheless, since there is now supposed to be evidence to the effect that each member of a pair of particles in such a state is causally dependent upon just one of the earlier particles.

Supporters of “fission as multiple occupancy” would recognize the evidence just described as supporting the same conclusion—namely, that states (iii) and (iv) must be distinguished, since one of the later particle-stages is non-branchingly immanent-causally connected with just one of the earlier ones. But they would also allow for a different sort of evidence for persistence on the basis of immanent-causal connections—evidence which would not necessarily conflict with that provided by quantum statistics, once the metaphysics of the situation is (by their lights) rightly understood. The multiple occupancy theorist would allow that evidence of immanent-causal connectedness between states of one particle at an earlier time and *both* particles at a later time counts as evidence that the original particle persists. By their lights, this would serve to establish the identity of “the” earlier particle with *both* of the later particles. Evidence that each earlier particle-stage was immanently-causally connected with each of the later particle-stages would support the conclusion that both persist; but it would not show that states (iii) and (iv) must be distinguished. In fact, if each persists “in the other”—each, as it were, fissioning and fusing with the other simultaneously—then it follows that the states (iii) and (iv) are the same. Each particle at the later time can be traced back to both *a* and *b*. So this sort of evidence for persistence would not conflict with the statistical evidence for non-persistence; in fact, it would explain why states (iii) and (iv) cannot be distinguished.

I move on to the second point: Suppose no such evidence for immanent-causal connections is forthcoming, and we are forced to conclude that quarks, electrons, and whatever other elementary particles there might be, are non-persisting. It is not obvious to me that this would imply that there are no persisting homeomerous substances. For a homeomerous substance must merely have no *parts* not of the same kind as itself; and it may be that a thing could be in some sense *dependent upon* non-persisting quarks, say, while not having them among its literal *parts*. These are deep waters, and their navigation would require a clear distinction between the kind of dependence appropriate to wholes and parts and some other kind of non-mereological dependence appropriate to “emergent” homeomerous substances and the underlying phenomena which “support” but do not constitute them. It is not crystal clear to me that the only kind of dependence relations holding among distinct categories of substances are mereological ones; consequently, there appears to remain at least the abstract possibility of homeomerous persisting objects that are dependent from moment to moment upon the existence of a series of non-persisting homeomerous substances of a different kind.

Finally, a word about the usefulness of immanent causation in the defense of the doctrine of temporal parts. I explore this issue in detail elsewhere⁷²; but I

must report that my results are rather discouraging, at least from the point of view of the friends of temporal parts. Some of the problems that arise given the possibility of homogeneous substances can be dealt with by introducing differences in immanent-causal connections among the parts of the stages of such stuff—but not while preserving the supervenience of the causal upon the noncausal, and not without giving up a Russellian theory about instantaneous states of motion.⁷³ Defending the doctrine of temporal parts from “the homogeneous stuff objection” requires an appeal to immanent causation. But the price of this defense turns out to be considerably higher than expected. It may well be beyond the means of most of the friends of temporal parts.

Appendix A: The analysis of the intrinsic

It is not easy to formulate a reasonably informative analysis of the intrinsic.⁷⁴ The following two definitions, for example, can only constitute *prima facie* marks of the intrinsic:

(D2) *P* is potentially temporally intrinsic =_{df} there is no property *Q* such that either:
 (a) necessarily, if something has *P* then something either did or will have *Q*; or
 (b) necessarily, if something has *P* then either it was not the case that something had *Q* or it will not be the case that something has *Q*.⁷⁵

(D3) *P* is potentially spatially intrinsic =_{df} there is no property *Q* such that either: (a) necessarily, if something has *P* then there is something outside its boundaries that has *Q*; or (b) necessarily, if something has *P* then it is not the case that there is something outside its boundaries that has *Q*.

These criteria jointly constitute mere *potential* intrinsicness only because of problems posed by disjunctive properties, like *being red or three feet from a pig* and *being round or the only thing that exists*.⁷⁶ Such properties (if indeed they are properties and not, as some believe, mere “concepts” to which no real universals correspond) are *potentially* spatially and temporally intrinsic; but they can be possessed by something “in virtue of” its possession of a property that fails to satisfy one or both of these definitions.

There are a couple of ways in which one could try to shore up this hole. One might, for example, presuppose some kind of “logical atomism”; there is a basic stock of non-disjunctive, nonconjunctive, simple properties. Certain of these (perhaps all of them?) pass tests of intrinsicness; any property reached through property-building operations of conjunction, disjunction, and negation working only from the stock of simple intrinsics is itself intrinsic. Anything built in part out of a simple property that fails these tests, or out of a relation, is itself extrinsic. I would be reluctant to take this route myself, in case there are any families of complex properties each of which involves at least one of the others but none of which is “built” entirely out of simple properties. Perhaps the ethical and the modal constitute two such families of properties. And the possibility of infinite complexity is also worrisome; do we really want to rule out, on *a priori* grounds, the possibility of properties that do not admit of analysis into any set of simple properties?

An alternative is to appeal to a rather rich notion of parthood for properties—a notion which others have attempted to explicate in a variety of ways.⁷⁷ If there is such a property as *being either [red and three feet from a pig] or [red and not three feet from a pig]*, surely it includes *being three feet from a pig* as a part in way that *being red* does not; and this

despite the fact that, necessarily, something has the one if and only if it has the other. Similarly for *being both [either red or three feet from a pig] and [either red or not three feet from a pig]*; this, too, has a part that *being red* lacks, despite their necessary coextension. These gerrymandered properties have *being three feet from a pig* among their “Boolean parts”—where a Boolean part of a property is one that can be reached by successive eliminations of disjuncts, conjuncts, and the ontological analogue of the negation operator.⁷⁸ But *being red* itself does not have such a part. This suggests the following test for “complete intrinsicness”, a category which rules out the above two gerrymandered properties in virtue of their containing parts that are not potentially intrinsic.

- (D4) *P* is a completely intrinsic property =_{df} every property that is a Boolean part of *P* is potentially temporally intrinsic and potentially spatially intrinsic.

The category can then be expanded to arrive at a more general account of intrinsicness that allows *some* of the gerrymandered properties to qualify as intrinsic as well.

- (D5) *P* is an intrinsic property =_{df} *P* is necessarily equivalent to a completely intrinsic property.

Appendix B: Searle’s analysis of the determinate-determinable relation

John Searle distinguishes the determinate-determinable relation from the species-genus relation in this way: In the case of properties A and B related by either relation, the more specific property A will entail the less specific property B but not the reverse—where one property entails or implies another just in case, necessarily, anything that has the former has the latter as well. But “A and B will *not* stand in the relation of species to genus if there is no term C such that the conjunction of B and C entails A, but [it is] not [the case that] C by itself entails B...”⁷⁹

Could we not arrive at a property equivalent to redness by conjoining *being colored* with the property of *being neither yellow nor green nor blue...*? Searle points out that the added property in such cases is “clearly logically related in some way” to the determinable—for the negation of the added property in this case entails *being colored*. And so he amends the last line of the criterion cited above to read: it is not the case that either C *or its negation* by itself entails B.⁸⁰

A number of pretenders to the true determinate-determinable relation must still be ruled out. One phony case of determinate-determinable is that of a genuine determinate to which some extraneous property has been added. *Being red and round*, although it entails and is not entailed by *being colored*, is not exactly a determinate of *being colored* either. Searle’s attempt to block such conjunctive properties is not entirely satisfactory: “We eliminate this class of cases by requiring that if A is a specifier of B [i.e. A entails but is not entailed by B] then A must not be equivalent to a set of terms such that one (or more) of them entails B while the others do not.” Unfortunately, given his definition of “equivalent” as “entails and is entailed by”, even redness turns out to flunk as a determinate of color; for redness entails and is entailed by the conjunctive property *being both [red or round] and [red or shaped but not round]*, neither conjunct of which entails the determinable *being colored*. Here I appeal once again to the strong notion of parthood for properties used in the appendix A definition of intrinsicness. If there really is a property corresponding to the conjunction of disjunctions just introduced as a counterexample, and if it really is distinct from *being red*, then the difference must surely lie in the fact that the gerrymandered

property has parts that *being red* lacks. And so, if one must worry about this property, the extraneous parts can be reached by snipping it at its Boolean joints. My revision of Searle's condition, then, is this: in the case of determinate and determinable, every Boolean part of the determinate entails the determinable.

One last important feature of determinables and determinates is aptly described by Searle:

Genuine determinates under a determinable compete with each other for position within the same area, they are, as it were, in the same line of business, and for this reason they will stand in certain logical relations to each other.⁸¹

Determinates like *being red* and *being yellow* exclude one another; a "sub-determinate" of the "super-determinate"⁸² property *being red*, like *being scarlet*, also stands in logical relations to all other determinates under the same determinable; *being scarlet* excludes, for example, *being yellow*, even though they are not "on the same level". This provides Searle with the means to rule out disjunctions, like *being either yellow or angry*, as determinables under which each disjunct would fall as a determinate. For in such cases there will be candidates for determinates under the supposed determinable which do not stand in logical relations to one another—that is, neither one implies nor excludes the other or its negation.

Putting these Searlean criteria together yields the following:

- (D10) *F* is a determinate falling under determinable *G* =_{df} (1) *F* implies *G*, but *G* does not imply *F*; (2) there is no property *H* such that: (a) *G* & *H* implies *F* but (b) neither *H* nor *not-H* implies *G*; (3) every Boolean part of *F* implies *G*; and (4) for every property *I* such that *I* and *G* satisfy the preceding three clauses, *F* and *I* stand in some logical relation.

Appendix C: Immanent causation within a probabilistic framework

Theories of probabilistic causation typically take as their point of departure the idea that an event which causes some effect must do so by raising the probability of the effect. Ellery Eells⁸³ has made a good case for understanding the relevant notion of "probability raising" more or less as follows:

- (PN) *x*-having-*F* probabilistically causes *y*-having-*G* in *T* if and only if for some period which just ended and some number *n*, the probability of *y*-having-*G* (in *T*+the distance into the past from the present) was *n*; but, from now on, the probability of *y*-having-*G* (in *T* less the distance into the future from the present) will be greater than *n* (as assessed according to certain restrictions).

Eells argues that the complicated restrictions relative to which future probabilities must be assessed include the following: when determining the probability of the potential effect *y*-having-*G*, do not hold fixed any events that are themselves *probabilistically caused* by the potential cause *x*-having-*F*. So unfortunately it appears that there is no possibility of (PN)'s providing a reductive analysis of probabilistic causation in terms of probability raising. Still, Eells's theory seems to me to be the most promising probabilistic theory of causation currently available, and it provides a concrete framework for the formulation and assessment of causal claims.

In the explication of causation in the body of the present paper, the notion of a partial cause is defined in terms of being a part of a sufficient condition. This procedure in effect builds the background conditions or “causal field” into the causally sufficient condition; certain parts of such a condition or “total cause” contribute to the effect and count as partial causes. Probabilistic theories of causation determine whether an event is a cause of a given effect by assessing the probability of the effect given the potential cause—and this assessment is made against the background of actual circumstances. So the “causal field” comes into play here as well, but as a part of what is relevant to assessing probabilities.

“Probabilistic cause” in (PN) corresponds, then, closely to the notion of a “partial cause” in my original (D9), and a probabilistic version of the theory of immanent causation can be obtained simply by substituting “probabilistically causes” for “is a partial cause of” in (D12), the definition of “intrinsic cause”. At only one point does the generic notion of causation come into play again in the rest of the theory: (D15). This definition can be replaced by:

- (D15^P) Stage x of a mass of K is *immanent-causally connected* to stage y of a mass of $K =_{df}$ (1) x and y are intrinsically causally connected stages of masses of K ; and (2) for any z and u such that: (a) z is temporally between x and y , (b) u is a stage of a mass of K that is intrinsically causally connected to x or y , and (c) z probabilistically causes u -having- P , where P falls under an essential intrinsic determinable of u , there is a stage v of a mass of K that is (i) intrinsically causally connected to x and y , (ii) simultaneous with z , and (iii) a proximate intrinsic cause of u .

It is a simple matter, then, to transplant my account of immanent causation from its original deterministic setting into the context of Eells’s probabilistic theory. And I strongly suspect that any theory of events and causation—at least, any theory with the resources to deal adequately with the facts about cause and effect which comprise the “data” for such theories—will invariably provide the means for defining immanent causation in accordance with the intuitions to which I have appealed.

Notes

* I am especially indebted to David Armstrong for good advice, and for furnishing unpublished material. The central ideas of the paper were presented in a talk at Wayne State University in the fall of 1995. I am grateful to the members of the audience, in particular Larry Powers, Larry Lombard, and Bruce Russell, for helpful criticisms and suggestions.

1. *Metaphysic (In Three Books: Ontology, Cosmology, and Psychology)*, 2nd ed., Vol. I, ed. by Bernard Bosanquet (Oxford: at the Clarendon Press, 1887), p. 116 (Bk. I, Ch. iv).
2. W. E. Johnson, *Logic*, Part III (Cambridge: Cambridge University Press, 1924), p. 128.
3. Lotze, *Metaphysic*, p. 115.
4. Lotze, *Metaphysic*, p. 116.
5. Lotze, *Metaphysic*, p. 156.
6. Cf. C. D. Broad, *The Mind and Its Place in Nature* (London: Routledge and Kegan Paul, 1925), p. 27.

7. Johnson, *Logic*, Part III, p. xxv.
8. Johnson, *Logic*, Part III, p. 129.
9. Broad, *Perception, Physics, and Reality* (Cambridge: Cambridge University Press, 1914), pp. 102–103.
10. *Perception, Physics, and Reality*, pp. 104–105.
11. Cf. John Morreall, “Smooth Replicas”, *Philosophical Studies* 38 (1980), pp. 101–103.
12. The expression is Chris Swoyer’s; cf. Swoyer, “Causation and Identity”, *Midwest Studies in Philosophy* 9, ed. by Peter A. French, Theodore E. Uehling, Jr., and Howard K. Wettstein (Minneapolis, Minnesota: University of Minnesota Press, 1984), p. 598.
13. Shoemaker, “Identity, Properties, and Causality”, reprinted in his *Identity, Cause, and Mind* (Cambridge: Cambridge University Press, 1984), pp. 234–260; and Armstrong, “Identity Through Time”, in *Time and Cause*, ed. by Peter van Inwagen (Dordrecht: D. Reidel, 1980), pp. 67–78.
14. Cf. Armstrong, “Identity Through Time”; and Swoyer, pp. 598–99.
15. Armstrong, “Identity Through Time”, p. 76.
16. “The Relation of Sense-data to Physics”, *Mysticism and Logic* (Garden City, NY: Doubleday, 1957; first published, 1917), p. 165.
17. Russell, *Philosophy* (a.k.a. *An Outline of Philosophy*) (New York: W. W. Norton, 1927), p. 119.
18. One can easily see, for instance, how causal dependence of later stages upon earlier stages follows from both Peter van Inwagen’s and Peter Unger’s views about persistence conditions for human beings. Cf. van Inwagen, *Material Beings* (Ithaca: Cornell University Press, 1990) and Unger, *Identity, Consciousness and Value* (New York: Oxford University Press, 1990).
19. Armstrong, *A World of States of Affairs* (Cambridge: Cambridge University Press, 1997), p. 73.
20. Armstrong, *A World of States of Affairs*, p. 74.
21. “Theories of Masses and Problems of Constitution”, *Philosophical Review* 104 (1995), pp. 53–110. The material in the present section summarizes some of the conclusions for which I argue at length in this paper.
22. For discussion of syntactic criteria for mass terms, cf. Francis Jeffry Pelletier, “Non-Singular Reference: Some Preliminaries”, in *Mass Terms: Some Philosophical Problems*, ed. Pelletier (Dordrecht: D. Reidel, 1979), pp. 1–14; and Francis Jeffry Pelletier and Lenhart K. Schubert, “Mass Expressions”, in *Handbook of Philosophical Logic: Volume IV* (Topics in the Philosophy of Language), ed. D. Gabbay and F. Guenther (Dordrecht: D. Reidel, 1989), pp. 327–407.
23. Burge, “Truth and Mass Terms”, *Journal of Philosophy* 69 (1972), pp. 263–82; cf. esp. p. 263.
24. This constitutes the main thesis for which I argue in “Theories of Masses”; cf. especially pp. 85–104.
25. Cf. “The Calculus of Individuals and its Uses”, *Journal of Symbolic Logic* 5 (1940), pp. 44–55.
26. The term “atomless gunk” was coined by David Lewis; cf. *Parts of Classes* (Oxford: Basil Blackwell, 1990), p. 20.
27. The label “Oriental Boxes” is from Martin Gardner, *The Whys of a Philosophical Scrivener* (Brighton: Harvester Press, 1983), p. 26. Rudy Rucker considers the hypothesis that quarks are made of “darks”, etc., in *Infinity and the Mind* (New York: Bantam Books, 1982), p. 28.

28. Cf. Broad, *The Mind and its Place in Nature*, pp. 35–37; Armstrong, “Identity Through Time”, pp. 76–78. For accounts of the arguments in Kripke’s much-discussed but unpublished lectures on identity through time, cf. Sydney Shoemaker, “Identity, Properties, and Causality”, reprinted in his *Identity, Cause, and Mind* (Cambridge: Cambridge University Press, 1984), pp. 234–260, esp. pp. 242–247; Harold Noonan, “Substance, Identity and Time” (in symposium with E. J. Lowe), *Proceedings of the Aristotelian Society*, Suppl. Vol. 62 (1988), pp. 79–100, esp. pp. 94–98; and Denis Robinson, “Matter, Motion, and Humean Supervenience”, *Australasian Journal of Philosophy* 67 (1989), pp. 394–409.
29. For the use of immanent causation to solve this problem, cf. Armstrong, “Identity Through Time”, pp. 76–78; and Sydney Shoemaker, “Identity, Properties, and Causality”, pp. 242–47.
30. “Identity Through Time”, p. 76.
31. “Identity, Properties, and Causality”, p. 255.
32. In this section, my indebtedness to Jaegwon Kim goes very deep: Kim himself suggests that mereological determination be construed as a kind of “multiple domain supervenience”; and my argument from supervenience to informative conditions is obviously inspired by his arguments against nonreductive physicalism. Cf. “Supervenience for Multiple Domains” and “The Myth of Nonreductive Materialism”, both reprinted in his *Supervenience and Mind* (Cambridge: Cambridge University Press, 1993).
33. In ordinary use, “intrinsic” can suggest “essential” or “internal”. Both connotations are absent in the characteristic philosophical use of the word to which I appeal here.
34. Cf. entry for the verb “chisholm” in *The Philosophical Lexicon*, ed. by Daniel Dennett (Newark, Delaware: American Philosophical Association, 1987). Cf. also entry for “brownian motion”, of which there shall be a good deal in the sequel.
35. This corresponds to Kim’s criterion for “structure-specific” indiscernibility (“Supervenience for Multiple Domains”, pp. 115–116). If more than symmetrical dyadic relations are needed in the supervenience base, obvious modifications may be introduced to ensure indiscernibility with respect to them as well.
36. Of course, if one accepts this moral, then *being a human being* begins to look like an *extrinsic* property. For *being a human being* is taken to imply that, for any *x* that has it, there are no skin cells outside of *x*’s boundaries that are attached to *x*; and thus *being a human being* is not even “potentially spatially intrinsic”—cf. (D3), p. 462.
37. Cf. Peter Geach, *Reference and Generality*, 3d ed. (Ithaca: Cornell University Press, 1980), pp. 215–218.
38. Compare Chisholm, *Person and Object*, pp. 102–103.
39. (MS) with the supervenience base restricted to just intrinsic properties along with spatiotemporal and causal relations, should be compared with Harold Noonan’s formulation of “the only *x* and *y* principle” in his *Personal Identity* (London and New York: Routledge, 1989), p. 164.
40. E. J. Lowe would, I suspect, deny that the existence of informative diachronic criteria of identity follows from these considerations. The grounds he would give (taken, *mutatis mutandis*, from his example concerning a tomato) are that momentary *K*-stages are not “individuable” or “identifiable” without presupposing in some way the notion of some persisting *K* [cf. Lowe, “Substance, Identity and Time”, *Proceedings of the Aristotelian Society*, Suppl. Vol. 62 (1988), pp. 61–78; esp. pp. 67–71. I do not think the friends of temporal parts should be convinced by his arguments for this conclusion, but I will not take up the issue here.

41. It seems that a growing number of philosophers are attracted to this view. Cf., for example, George I. Mavrodes, "The Life Everlasting and the Bodily Criterion of Identity", *Noûs* 11 (1977), pp. 27–39; Baruch Brody, *Identity and Essence* (Princeton, N.J.: Princeton University Press, 1980), pp. 49–59; P. T. Mackenzie, "Personal Identity and the Imagination", *Philosophy* 58 (1983), pp. 161–174; E. J. Lowe, *Kinds of Being* (Oxford: Basil Blackwell, 1989), pp. 121–137; David S. Oderberg, *The Metaphysics of Identity Over Time* (New York: St. Martin's Press, 1993); and Trenton Merricks, "Fission and Personal Identity Over Time", forthcoming in *Philosophical Studies*.
42. My final analysis is in keeping with Denis Robinson's claim that "our concept of *some matter* is the concept of a sufficiently large cluster of properties coinstantiated throughout some region, more or less mutually coupled, and sufficiently independent, when propagating in unison, of the nonmembers of that set" ["Re-identifying Matter", *Philosophical Review* 91 (1982), pp. 317–341; quotation is from p. 334].
43. Kim, "Causation, Nomic Subsumption, and the Concept of Event", reprinted in his *Supervenience and Mind*, pp. 3–21.
44. "Events Without Times: An Essay On Ontology", *Noûs* 24 (1990), pp. 413–428. For discussion of the motivations for doing without times, cf. my "Chisholm and the Essences of Events", in *The Philosophy of Roderick M. Chisholm (Library of Living Philosophers)*, ed. by Lewis E. Hahn (LaSalle, Ill.: Open Court), forthcoming.
45. Cf. "Chisholm and the Essences of Events".
46. For details, cf. "Chisholm and the Essences of Events".
47. For those who want it, allowance could be made within my framework for backwards causation; simply let *T* take negative values in the nonsimultaneous cases.
48. Cf. Fred Dretske, "Laws of Nature", *Philosophy of Science* 44 (1977), pp. 248–68; Michael Tooley, "The Nature of Laws", *Canadian Journal of Philosophy* 4 (1977), pp. 667–698; and David M. Armstrong, *What Is a Law of Nature?* (Cambridge: Cambridge University Press, 1983).
49. For criticism, cf. David Lewis, "New Work for a Theory of Universals", *Australasian Journal of Philosophy* 61 (1983), pp. 343–77 (cf. especially pp. 365–66).
50. Cf. Kim, "Causation, Nomic Subsumption, and the Concept of Event"; and J. A. Foster, "Psychophysical Causal Relations", *American Philosophical Quarterly* 5 (1968), pp. 64–70.
51. Russell's argument is found at the beginning of "On the Notion of Cause" in his *Mysticism and Logic*. The argument is revived, but with the same dependence on the assumption I reject, by A. David Kline, "Humean Causation and the Necessity of Temporal Discontinuity", *Mind* 94 (1985), pp. 550–56.
52. This definition should be compared with the simpler notion of parthood for events defined by Chisholm; cf. Chisholm, *A Realistic Theory of Categories* (Cambridge: Cambridge University Press, 1996), p. 83.
53. *Logic* Part III, p. 129.
54. *Metaphysic*, p. 119 (Bk. I, Ch. iv); cf. also his description of "receptivity", p. 124.
55. Lotze, p. 124.
56. Lotze, p. 124.
57. Lotze, pp. 138–139.
58. Johnson, *Logic* Vol. I (Cambridge: Cambridge University Press, 1921), pp. 175–176.
59. *Versuch über die Erkenntnis*, ed. by A. Kastil (Leipzig: Felix Meiner, 1925), p. 29; the translation is Roderick Chisholm's, found in his "The Objects of Sensation: A Brentano Study", *Topoi* 8 (1989), pp. 3–8 (the translated passage is on p. 5).

60. Johnson, *Logic* Part III, p. 67. Earlier, Johnson links these assumptions to a semantic thesis about the nature of propositions in which such determinables figure: "The view then that I hold is not merely that what is given is a 'thing' in the widest sense of the term thing, but that what is given is always given as demanding to be characterised in certain definite respects—e.g. colour, size, weight; or cognition, feeling, conation—and that therefore such a proposition as 'The given thing is *MP*' [where *M* and *P* designate determinables] is presupposed in its being given, i.e. in being given, it is given as requiring determination with respect to these definite determinables *M* and *P*." [Johnson, *Logic* Part II (Cambridge: Cambridge University Press, 1922), p. 18.] The peculiar doctrine to which Johnson is led by these considerations, namely that "The given thing is *MP*" is neither true nor false but a merely "structural" proposition, is quite independent of the metaphysical thesis from which it springs. For criticism of Johnson's views concerning structural propositions, cf. A. N. Prior, "Determinables, Determinates and Determinants", *Mind* 58 (1949), pp. 1–20 and 178–194; cf. esp. pp. 17–20.
61. The notion of a completely intrinsic property is defined in (D4) of appendix A. A completely intrinsic property not only *itself* fails to imply anything about what happens elsewhere or elsewhen; it also has no *parts* that have such implications. Thus, if there is such a property as *being both [either red or three feet from a pig] and [either red or not three feet from a pig]*, it will not be *completely* intrinsic in virtue of the fact that it has *being three feet from a pig* as a part.
62. Cf. Armstrong, *A Theory of Universals (Universals and Scientific Realism, Vol. II)* (Cambridge: Cambridge University Press, 1978), pp. 117–120.
63. This is David Lewis's well-known response to problems of fission and fusion for persons. Cf. "Survival and Identity", reprinted in his *Philosophical Papers* Vol. 1 (New York and Oxford: Oxford University Press, 1983), pp. 55–77.
64. Larry Powers walks up to me outside a Chinese restaurant in Detroit and says: "There are these two chameleons mating...". The chameleons are two, but the color, shape, and other intrinsic properties of the one help to determine the color, shape, and so on, of the other. Is there a counterexample to my analysis in the neighborhood of Powers's story? I think not. For the chameleons are not homeomerous masses; a chameleon has parts that are not themselves chameleons, and some of these parts (heart, brain, etc.) must themselves persist if the chameleon is to persist. The criteria of diachronic unity for chameleons are clearly much more complex than those for homeomerous masses (no surprise, since chameleons are themselves more complex than homeomerous masses); but this much surely is true. So even if certain essential intrinsic determinables of a pair of chameleons are causally intertwined in this way, there is much more to chameleon-persistence than just the propagation of such properties.

A story involving "two" homeomerous masses similarly coupled (or coupling) becomes very difficult to grasp: each is dependent for its present shape, mass, color, etc. upon its own earlier shape, mass, color, etc. and also upon the earlier intrinsic properties of the other; and each part of one is similarly dependent upon earlier states of its parts and also upon earlier states of parts of the other. The intimacy of these "two" masses has become so great that it constitutes, I believe, a peculiar case of "double fission"—each mass, and each proper part of each mass, divides; but the result is, oddly, not four masses, but just two. And neither of the resulting masses can be traced back to just one of the original masses. What the temporal parts theorist will want to say about this case depends upon her views concerning fission and fusion; for it is just a special (albeit weird) case of fission and fusion. But this possibility does not

- pose any obstacle in principle to the present account of immanent causation. (For a description of a case of this sort inspired by the anomalies of quantum statistics, and an account of what the multiple occupancy theorist would say about it, cf. section IX.)
65. For details on the distinction between “endurantists” and “perdurantists”, cf. my “Persistence and Presentism”, *Philosophical Papers* 25 (1996), pp. 115–126.
 66. For endurantists who defend a “further fact” view of personal identity along these lines, cf. Chisholm, *Person and Object*, pp. 104–113; and Richard Swinburne, *The Evolution of the Soul* (Oxford: Clarendon Press, 1986), Ch. 8. For discussion, and use of the terminology of “further facts”, cf. Derek Parfit, *Reasons and Persons* (Oxford: Oxford University Press, 1986), Part 3.
 67. Erwin Schrödinger, “What is an Elementary Particle?”, in *Space, Time, and the New Mathematics*, ed. by Robert W. Marks (New York: Bantam Books, 1964), pp. 100–115; quotation from p. 107.
 68. Erwin Schrödinger, “What is an Elementary Particle?”, pp. 108–109.
 69. Cf. Steven French, “Identity and Individuality in Classical and Quantum Physics”, *Australasian Journal of Philosophy* 67 (1989), pp. 432–446; J. Tershoff and D. Bayer, “Quantum Statistics for Distinguishable Particles”, *Physical Review Letters* 50 (1983), pp. 553–54; and Bas C. van Fraassen, “Probabilities and the Problem of Individuation”, in *Probabilities, Problems, and Paradoxes*, ed. by Sidney A. Luckenbach (Encino and Belmont, California: Dickenson, 1972), pp. 121–138.
 70. Cf. Michael Redhead and Paul Teller, “Particle Labels and the Theory of Indistinguishable Particles in Quantum Mechanics”, *British Journal for the Philosophy of Science* 43 (1992), pp. 201–218.
 71. For discussion of the import of this line of argument, cf. van Fraassen, “Probabilities and the Problem of Individuation”; Jonathan Powers, *Philosophy and the New Physics* (London and New York: Methuen, 1982), pp. 153–58; and Richard Swinburne, “Thisness”, *Australasian Journal of Philosophy* 73 (1995), pp. 389–400, esp. p. 394.
 72. “The Homogeneous Stuff Objection to the Doctrine of Temporal Parts”, *Australasian Journal of Philosophy*, 76 (March 1998).
 73. For a description and criticisms of Russellianism about states of motion, cf. Michael Tooley, “In Defense of the Existence of States of Motion”, *Philosophical Topics* 16 (1988), pp. 225–54.
 74. For some attempts and related criticisms, cf. Chisholm, *Person and Object* (LaSalle, Illinois: Open Court, 1976), p. 127; Jaegwon Kim, “Psychophysical Supervenience”, *Philosophical Studies* 41 (1982), pp. 51–70, reprinted in Kim’s *Supervenience and Mind*, pp. 175–193 (cf. especially p. 184 in the latter volume); and David Lewis, “Extrinsic Properties”, *Philosophical Studies* 44 (1983), pp. 197–200. In an as-yet-unpublished paper, “Defining Intrinsic”, Rae Langton and David Lewis develop an analysis approximately equivalent to mine. Our conclusions were reached independently.
 75. Notice that (b) rules out such properties as being the first event or the last event.
 76. A proposal in the spirit of this one is considered by David Lewis, in “Extrinsic Properties”, and rejected for its failure to cope with disjunctions of this sort.
 77. There is David H. Sanford’s method of distinguishing various kinds of disjunctive, conjunctive, and independent predicates in terms of their boundaries; and Chisholm’s intentional procedure, dividing properties along lines marking our ability to conceive of them independently. Cf. Sanford, “A Grue Thought in a Bleen Shade: ‘Grue’ as a Disjunctive Predicate”, in *Grue! The New Riddle of Induction*, ed. by Douglas Stalker (Chicago and La Salle, Ill.: Open Court, 1994), pp. 173–192; and Chisholm, “Properties and States of Affairs Intentionally Considered”, reprinted in his *On Metaphys-*

- ics* (Minneapolis, Minn.: University of Minnesota Press, 1989), pp. 141–149. It is my hope that, on any sensible approach to the problem of determining whether one property is a negation of another, or a conjunction or disjunction of two others, the definitions below which make use of the notion of “Boolean part” will remain adequate.
78. Note that properties formed in nonBoolean ways, such as by attaching the modal property-building operator “necessarily exemplifying...” or the intentional operator “believing something to exemplify...” to a property, are treated as noncomposite by this test of intrinsicness.
 79. Searle (in symposium with Stephan Körner), “Determinables and the Notion of Resemblance”, *Proceedings of the Aristotelian Society*, Suppl. Vol. 33 (1959), pp. 141–158; quotation from p. 145.
 80. Searle, p. 146.
 81. Searle, p. 148.
 82. This is Johnson’s terminology; cf. *Logic* Vol. I, pp. 177–178.
 83. Cf. Eells, *Probabilistic causality* (Cambridge: Cambridge University Press, 1991), Ch. 6.